

**Amendments to the Specification:**

After the title and before the first line of the specification, please add the subheading:

**Background of the Invention**

Please delete the third full paragraph of page 3 in its entirety as follows:

~~This task is solved in accordance with the present invention through the characterizing features of the patent claims.~~

Before the last paragraph of page 3, please add the subheading:

**Summary of the Invention**

Please amend the last paragraph of page 3 which continues over to page 4 as follows:

Through the measures in accordance with the present invention, the gas flow through the gap is fully regenerated. The~~[[,]] in the instance of the state of the art substantially non-existing heat storing, respectively~~ regeneration ability of the surfaces encompassing the gap, is created in the instance of a refrigerator in accordance with the present invention by embedding a material having a high thermal capacity within the surfaces encompassing the gap on the outside of the displacing member and/or on the inside of the cylinder housing, for example. The performance of the refrigerator is thus not only improved in that an unwanted heat ingress into the expansion chamber is minimized ~~no longer takes place~~, but also in that the gas mass flow flowing through the regenerator of the displacing member being, in the instance of the state-of-the-art substantially effective alone, is increased by the regenerated gas mass flow through the gap.

Please amend the first full paragraph of page 4 as follows:

It is expedient to rate the storage ability of the gap gas regenerator such that the gap gas mass flow may increase with increasing operating time of the cold head without impairing the performance of the cold head. The ~~neecessary~~ sealing effect between displacing member and cylinder wall is subject, in the instance of a gap gas regenerator, to entirely new operating conditions. In principle, it is unimportant how high the gap gas mass flow is. ~~It is only neecessary that always so~~ So much heat is given off to the gap gas regenerator so that the gap gas mass flow enters into the expansion chamber at substantially the same temperature as that of the expansion chamber. A refrigerator in accordance with the present invention may be designed to be significantly less complex; above all, the seal can be significantly simplified or even omitted. Besides a production with easily to be implemented dimensional specifications, it is in addition possible to fall back on "standard sealing rings". Thus the cooler becomes cheaper, more simple and offers a longer service life.

Please amend the last paragraph of page 4 as follows and delete the two Translator's notes referenced therein in their entirety.

Especially advantageous is the ~~utilisation~~ utilization of the ~~[[<sup>1</sup>]]~~ idea in accordance with the present invention in the ~~[[<sup>2</sup>]]~~ second stage of a two-stage refrigerator.

<sup>1)</sup> ~~Translator's note: The German text states "er" here whereas "der" would be appropriate. Therefore the latter has been assumed for the translation.~~

<sup>2)</sup> ~~Translator's note: The German text states "er" here whereas "der" would be appropriate. Therefore the latter has been assumed for the translation.~~

Please delete the first paragraph on page 5, and add the following paragraph, subheading, and paragraph as follows:

~~Further advantages and details of the present invention shall be explained with reference to the examples of embodiments depicted in the drawing figures 1 to 4. Depicted is in~~

Still further advantages of the present invention will be appreciated to those of ordinary skill in the art upon reading and understand the following detailed description.

### **Brief Description of the Drawings**

The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating the preferred embodiments and are not to be construed as limiting the invention.

Please amend the first four sub-paragraphs of page 5 as follows:

[[ -]] ~~drawing figure~~ Figure 1[[,]] illustrates a two-stage refrigerator in accordance with the state-of-the-art,

[[ -]] ~~drawing figure~~ Figure 2[[,]] illustrates a partial sectional view of a gap gas regenerator in accordance with the present invention,

[[ -]] ~~drawing figure~~ Figure 3[[,]] illustrates a single stage refrigerator designed in accordance with the present invention, and

[[ -]] ~~drawing figure~~ Figure 4[[,]] illustrates a further solution for the design of a gap gas regenerator.

Before the second full paragraph of page 5, please insert the following subheading:

### **Detailed Description of the Preferred Embodiments**

Please amend the second full paragraph of page 5 which continues over to page 6 as follows:

In ~~drawing figure~~ Figure 1, a two-stage Gifford McMahon refrigerator 1 according to the state-of-the-art is depicted. In the housing 2 a valve system, not depicted in greater detail, of a basically known design is accommodated[[],]. The valve system ~~which in a certain~~ sequence connects a high-pressure and a low pressure gas source ~~being connected~~ to the connection ports 3 and 4, to the channels 5, 6 and 7. The channel 6 opens out into a cylinder 8 in which there is located a drive piston 12 with the displacing member 9 of the first stage 11 of the refrigerator. Instead of the piston drive also a crank drive may be employed. A ring sealing the piston 12 with respect to the inside wall of the cylinder 8 is designated as 13. With the aid of this drive, the displacing member 9 is reciprocated in the working chamber 15 formed by cylindrical housing 14. Through the pin 16 in the displacing member 17 of the second stage 18 of the refrigerator it is linked to the displacing member 9 of the first stage, such that also the displacing member 17 of the second stage performs a reciprocating motion in the working chamber 21 formed by the cylindrical housing 19. The axis of the entire system is designated as 10.

Please amend the second full paragraph of page 6 which continues over to page 7 as follows and delete the Translator's note referenced therein in its entirety.

The working gas is supplied, respectively discharged, through the channels 5 and 7. It flows through the bores 24, through the regenerator of the displacing member 9 and through the bores 37 into the expansion chamber 25 which is the bottom section of the working chamber 15. There the gas expands and removes heat from this area of the first stage 11 of the refrigerator. The pre-cooled gas flows further through the bore 27 in the displacing member 17 of the second stage 18, through the regenerator located in the inside chamber 20b of the displacing member 17 and through the bore 28 at the bottom end of the displacing member 17 into the expansion chamber 29 of the second stage 18. There a further expansion is effected

having in this area of the second stage a cooling effect. Through the same path the gas flows back and cools the regenerator materials so that the gases flowing in again in the next cycle are already pre-cooled in the regenerator. Sealing rings 31 and 32 which are accommodated in the outside grooves 33 and 34 of the walls of the displacing members serve the purpose of sealing the displacing members 9 and 17 with respect to their related chamber walls 14 and 19. The gaps <sup>3)</sup> between the displacing members 11, 17 and the cylindrical housings 14, 19 of the working chambers 15, 21 are designated as 36 and 38 respectively.

<sup>3)</sup> ~~Translator's note: The German text states "spalte" here whereas "Spalte" would be correct. Therefore the latter has been assumed for the translation.~~

Please amend the first full paragraph of page 7 as follows and delete the Translator's note referenced therein in its entirety.

~~Drawing figure~~ Figure 2 is a highly schematic partial sketch with a solution in accordance with the present invention which may be employed both in the first and also in the second stage of a refrigerator in accordance with ~~drawing figure~~ Figure 1. Through double arrows 41 in the regenerator (in hollow chamber 20a, 20b of the displacing member 9, respectively 17), respectively 42 (in gap 36, 38) the main gas mass flow and the gap gas mass flow are indicated. To the gap gas mass flow 42 an additional regenerator 43 is assigned. This is a single layer coil extending in the axial direction, being embedded on the gap side in the housing wall 22, 23 of the displacing member 9, 17. In the instance of employing the further generator 43 said coil ~~eonsists~~ is constructed in the first stage 9 of bronze wire <sup>4)</sup>, for example, and in the instance of being employed in the second stage it ~~eonsists~~ is constructed of lead, for example. It is true that also a seal 31, 32 is depicted; but it no longer needs to meet high sealing requirements. It may even be omitted provided it is ensured that the gap gas mass flow is regenerated substantially in its entirety.

<sup>4)</sup> ~~Translator's note: The German text states "(?)" for no apparent reason here. This has been omitted in the translation.~~

Please amend the first full paragraph of page 8 to read as follows:

~~Drawing-figure~~ Figure 3 depicts a single-flow embodiment of a refrigerator 1. In contrast to the solution in accordance with ~~drawing-figure~~ Figure 2 the gap gas regenerator 43 is a component of the housing wall 14 of the refrigerator housing. If need be, gap gas regenerators 43 of the kind detailed may also be arranged to both sides of the gaps 36, 38.

Please amend the second full paragraph of page 8 to read as follows:

~~Drawing-figure~~ Figure 4 finally depicts an embodiment with a gap gas generator 43 which in the depicted embodiment is integrated in the displacing member 17 of the second stage 18, specifically in the area of its warm end. For this purpose in housing 23 of the displacing member 17, a hollow chamber 44 is provided in which the regenerator material is located. Through axially spaced radial bores 45, 46 the hollow chamber 44 is linked on the inlet and at the discharge side to gap 38. Between the openings of the radial bores 45, 46 in the gap 38, there is located a seal 47. This seal too thus also does not need to meet high sealing requirements. It only needs to be ensured that the pressure difference which is created by the seal 47 is greater than the pressure difference created by the regenerator 43. In this manner it is achieved that the gases flowing from the warm side of the displacing member 17 to its cold side through the gap 38 almost entirely flow through the regenerator 43 so that the desired regeneration effect occurs also with respect to the gap gases.

Please amend the first paragraph of page 9 as follows:

In connection with the solution in accordance with ~~drawing-figure~~ Figure 4, a further variant is expedient. The chamber 44 may be linked through an approximately axially oriented bore directly to the channel 27. This solution has the effect that the pressure difference across the seal 47 is lower, in particular when bore 45 is ~~dispensed with~~ eliminated.

After the last paragraph of page 9, please insert the following paragraph:

The invention has been described with reference to the preferred embodiments. Modifications and alterations may occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be constructed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

On page 10, please delete the duplication of the title as follows:

**Refrigerator Comprising a Regenerator**

On page 10, after the heading "Patent Claims", please insert the following paragraph:

Having thus described the preferred embodiments, the invention is now claimed to be:

On page 11, please delete the two Translator's notes in their entirety.

5) ~~Translator's note: The German text states "18r" here whereas "17" would be more in line with the drawing figures and the remainder of the text. Therefore "17" has been assumed for the translation.~~

6) ~~Translator's note: The German text states "... vorgesehen ist, die in Bezug auf die Lage der Dichtung (47) am warmen Ende des Verdrängers (18) befindet." Whereas "... vorgesehen ist, die sich in Bezug auf die Lage der Dichtung (47) am warmen Ende des Verdrängers (18) befindet." would be correct. Therefore the latter has been assumed for the translation.~~